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CHI MEI OPTOELECTRONICS CORP.

Issued Date: Oct. 27, 2000
Model No.: N141X3 - 02
**Tentative**

# TFT LCD Tentative Specification

# MODEL NO.: N141X3 - 02

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| Liquid Crystal Display Division | | |
|---|---|---|
| QRA Dept. | RD Dept. | PD Dept. |
| Approval | Approval | Approval |
| | | |



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## REVISION HISTORY

| Version | Date | Page (New) | Section | Description |
|---|---|---|---|---|
| Ver 0.1 | Oct.27,'00 | All | All | Tentative Specification was first issued. |

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# 1. GENERAL DESCRIPTION

## 1.1 OVERVIEW

N141X3 - 02 is a 14.1" TFT Liquid Crystal Display module with single CCFL Backlight unit and 20 pins LVDS interface. This module supports 1024 x 768 XGA mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction. The inverter module for Backlight is not built in.

## 1.2 FEATURES

- 1 CCFLs (Cold Cathode Fluorescent Lamp)
- XGA (1024 x 768 pixels) resolution
- DE (Data Enable) only mode
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 1 pixel/clock

## 1.3 APPLICATION

- TFT LCD Notebook

## 1.4 GENERAL SPECIFICATI0NS

| Item | Specification | Unit | Note |
|---|---|---|---|
| Active Area | 285.7 (H) x 214.3 (V) (14.1" diagonal) | mm | (1) |
| Bezel Opening Area | 288.8 (H) x 217.4 (V) | mm | |
| Driver Element | a-si TFT active matrix | - | - |
| Pixel Number | 1024 x R.G.B. x 768 | pixel | - |
| Pixel Pitch | 0.279 (H) x 0.279 (V) | mm | - |
| Pixel Arrangement | RGB vertical stripe | - | - |
| Display Colors | 262,144 | color | - |
| Transmissive Mode | Normally white | - | - |
| Surface Treatment | Hard coating (3H), Anti-glare (Haze 12) | - | - |

## 1.5 MECHANICAL SPECIFICATIONS

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Module Size | Horizontal(H) | (298.0) | 298.5 | (299.0) | mm | (1) |
| | Vertical(V) | (227.0) | 227.5 | (228.0) | mm | |
| | Depth(D) | - | (5.7) | 6.0 | mm | |
| Weight | | - | (510) | 530 | g | - |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.



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## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Storage Temperature | $T_{ST}$ | -20 | +60 | ºC | (1) |
| Operating Ambient Temperature | $T_{OP}$ | 0 | +50 | ºC | (1), (2) |
| Shock (Non-Operating) | $S_{NOP}$ | - | 30 | G | (3), (5) |
| Vibration (Non-Operating) | $V_{NOP}$ | - | 1.5 | G | (4), (5) |

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. (Ta ≦ 40 ºC).

(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

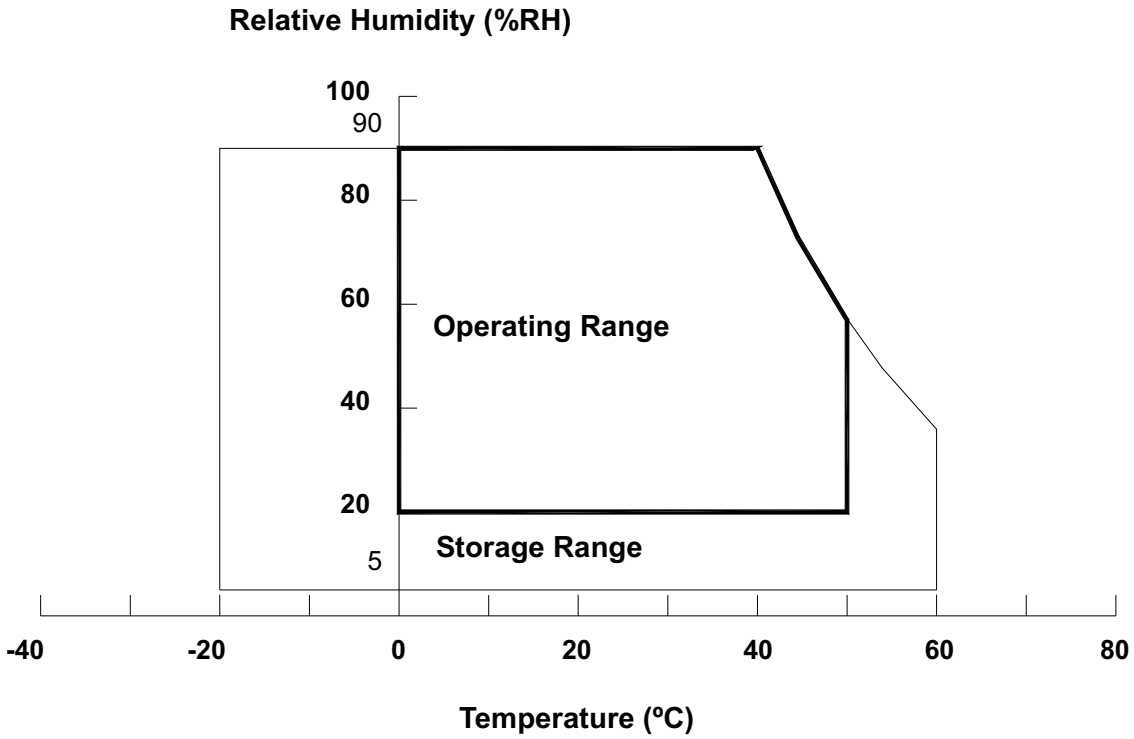
(c) No condensation.

Note (2) The temperature of panel surface should be 0 ºC Min. and 60 ºC Max.

Note (3) 6ms, sine wave, 1 time for ± X, ± Y, ± Z.

Note (4) 10 ~ 500 Hz, Sweep rate 20min, 60min for X,Y,Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



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## 2.2 ELECTRICAL ABSOLUTE RATINGS

### 2.2.1 TFT LCD MODULE

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Power Supply Voltage | Vcc | 3.0 | 3.6 | V | (1) |
| Logic Input Voltage | $V_{IN}$ | -0.3 | Vcc+0.3 | V | |

### 2.2.2 BACKLIGHT UNIT

| Item | Symbol | Value | | Unit | Note |
|---|---|---|---|---|---|
| | | Min. | Max. | | |
| Lamp Voltage | $V_L$ | - | - | $V_{RMS}$ | (1), (2), $I_L$ = (6.0) mA |
| Lamp Current | $I_L$ | 4.0 | 7.0 | $mA_{RMS}$ | (1), (2) |
| Lamp Frequency | $F_L$ | 40 | 70 | KHz | |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to 3.2 for further information).

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## 3. ELECTRICAL CHARACTERISTICS

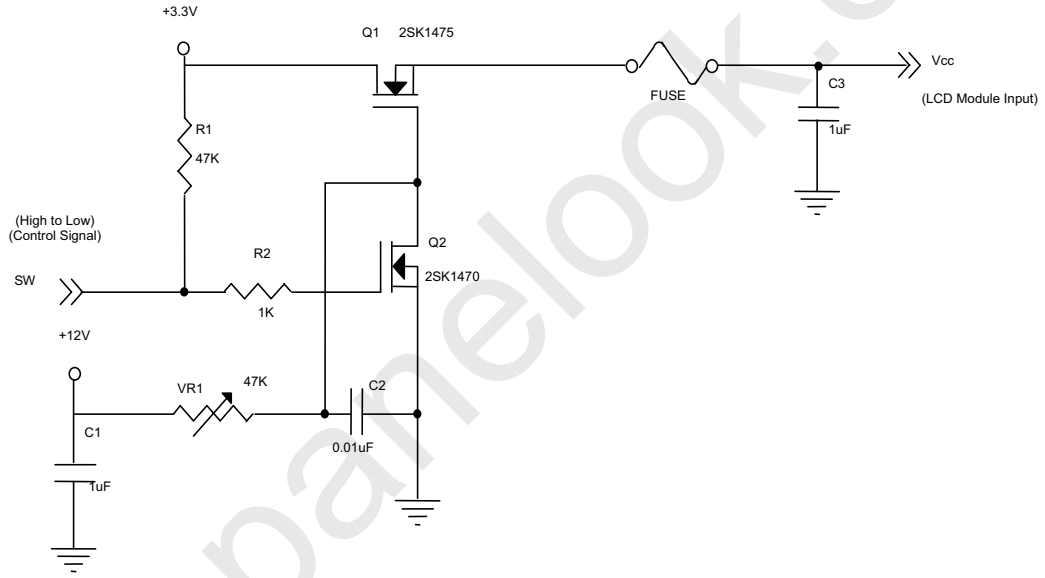
### 3.1 TFT LCD MODULE

Ta = 25 ± 2 ºC

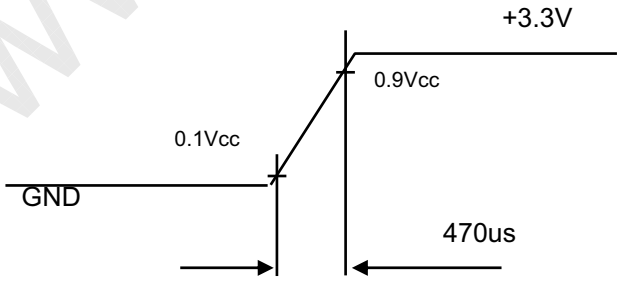
| Parameter | | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Power Supply Voltage | | Vcc | 3.0 | 3.3 | 3.6 | V | - |
| Ripple Voltage | | $V_{RP}$ | - | (50) | | mV | - |
| Rush Current | | $I_{RUSH}$ | - | (1.6) | (1.8) | A | (2) |
| Power Supply Current | White | Icc | - | TBD | | mA | (3)a |
| | Black | | - | TBD | | mA | (3)b |
| | TBD | | - | TBD | | mA | (3)c |
| Logical Input Voltage | "H" Level | $V_{IL}$ | - | - | +100 | mV | - |
| | "L" Level | $V_{IH}$ | -100 | - | - | mV | - |
| Terminating Resistor | | $R_T$ | - | 100 | - | Ohm | - |

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:




**Vcc rising time is 470us**



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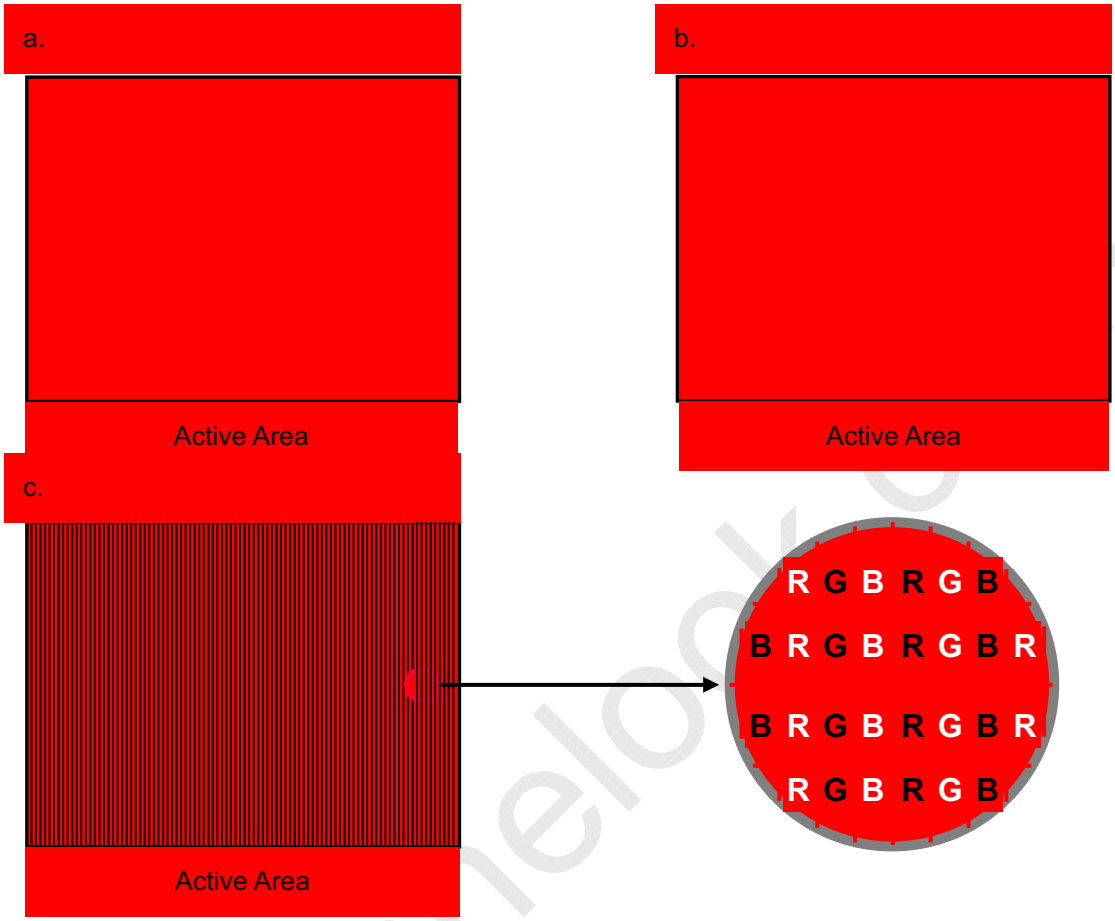
Note (3) The specified power supply current is under the conditions at Vcc = 3.3 V, Ta = 25 ± 2 ºC, $f_v$ = 60 Hz, whereas a power dissipation check pattern below is displayed.

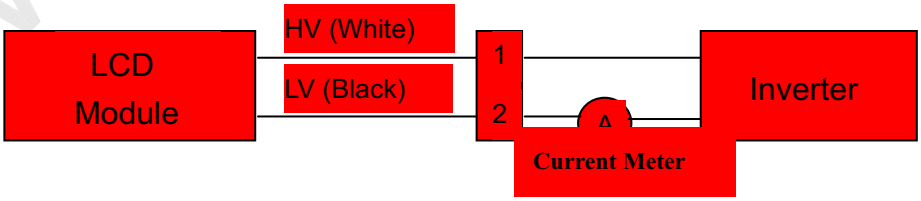



3.2 BACKLIGHT UNIT

Ta = 25 ± 2 ºC

| Parameter | Symbol | Value | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Lamp Input Voltage | $V_L$ | | 630 | | $V_{RMS}$ | $I_L$ = (6.0) mA |
| Lamp Current | $I_L$ | 4.0 | 6.0 | 7.0 | $mA_{RMS}$ | (1) |
| Lamp Turn On Voltage | $V_S$ | - | | 975 (25 °C) | $V_{RMS}$ | (2) |
| | | - | | 1170 (0 °C) | $V_{RMS}$ | (2) |
| Operating Frequency | $F_L$ | 40 | 55 | 70 | KHz | (3) |
| Lamp Life Time | $L_{BL}$ | 12000 | 20000 | - | Hrs | (5) |
| Power Consumption | $P_L$ | - | 4.2 | - | W | (4), $I_L$ = (6.0) mA |

Note (1) Lamp current is measured by utilizing a high frequency current meter as shown below:




Note (2) The voltage shown above should be applied to the lamp for more than 1 second after startup. Otherwise the lamp may not be turned on.



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Note (3) The lamp frequency may produce interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) $P_L = I_L \times V_L$

Note (5) The lifetime of lamp can be defined as the time in which it continues to operate under the condition Ta = 25 ±2 °C and $I_L$ = 6.0 mArms until one of the following events occurs:

(a) When the brightness becomes or lower than 50% of its original value.

(b) When the effective ignition length becomes or lower than 80% of its original value. (Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

Note (6) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid producing too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

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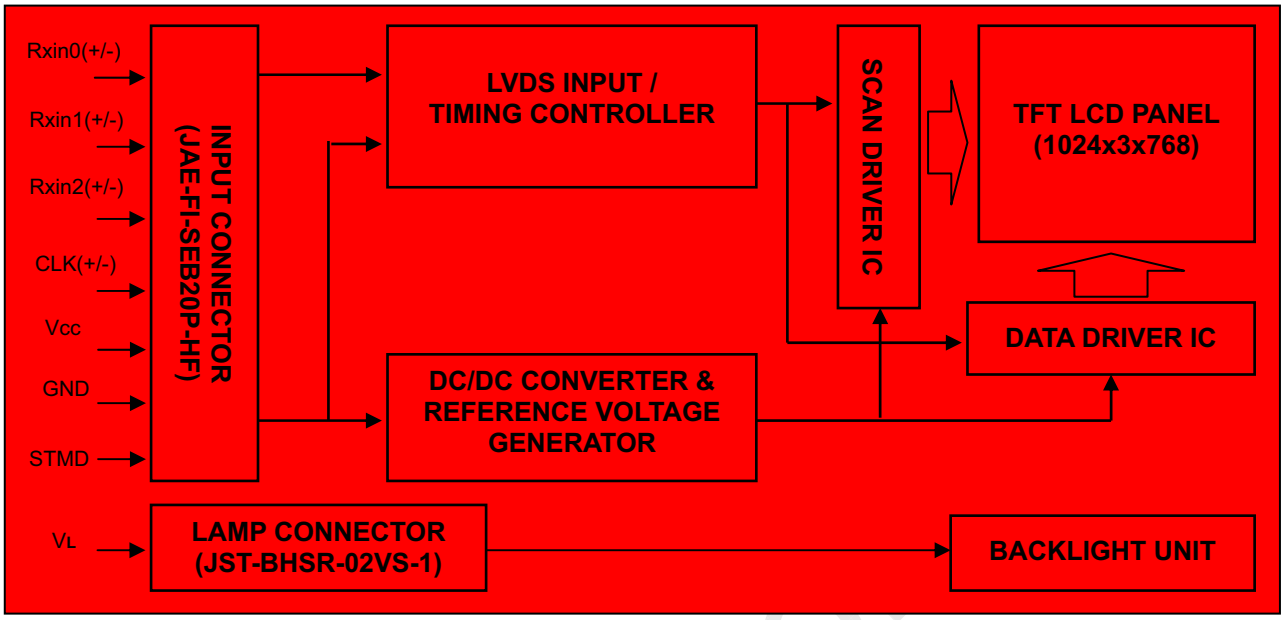
# 4. BLOCK DIAGRAM

## 4.1 TFT LCD MODULE




## 4.2 BACKLIGHT UNIT

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## 5. INPUT TERMINAL PIN ASSIGNMENT

### 5.1 TFT LCD MODULE

| Pin | Symbol | Description | Polarity | Remark |
|---|---|---|---|---|
| 1 | Vcc | Power Supply +3.3 V | | - |
| 2 | Vcc | Power Supply +3.3 V | | - |
| 3 | Vss | Ground | | - |
| 4 | Vss | Ground | | - |
| 5 | Rxin0- | LVDS Differential Data Input | Negative | R0~R5,G0 |
| 6 | Rxin0+ | LVDS Differential Data Input | Positive | |
| 7 | Vss | Ground | | - |
| 8 | Rxin1- | LVDS Differential Data Input | Negative | G1~G5,B0,B1 |
| 9 | Rxin1+ | LVDS Differential Data Input | Positive | |
| 10 | Vss | Ground | | - |
| 11 | Rxin2- | LVDS Differential Data Input | Negative | B2~B5,DE,Hsync,Vsync |
| 12 | Rxin2+ | LVDS Differential Data Input | Positive | |
| 13 | Vss | Ground | | - |
| 14 | CLK- | LVDS Clock Data Input | Negative | LVDS Level |
| 15 | CLK+ | LVDS Clock Data Input | Positive | |
| 16 | Vss | Ground | | - |
| 17 | NC | Non-Connection | | - |
| 18 | STMD | Standard mode selection | | See Section 6.1 |
| 19 | Vss | Ground | | - |
| 20 | Vss | Ground | | - |

Note (1) Connector Part No.: JAE-FI-SEB20P-HF13R or equivalent

Note (2) User's connector Part No: JAE-FI-S20S or FI-SE20M(JAE)

Note (3) The first pixel is even.

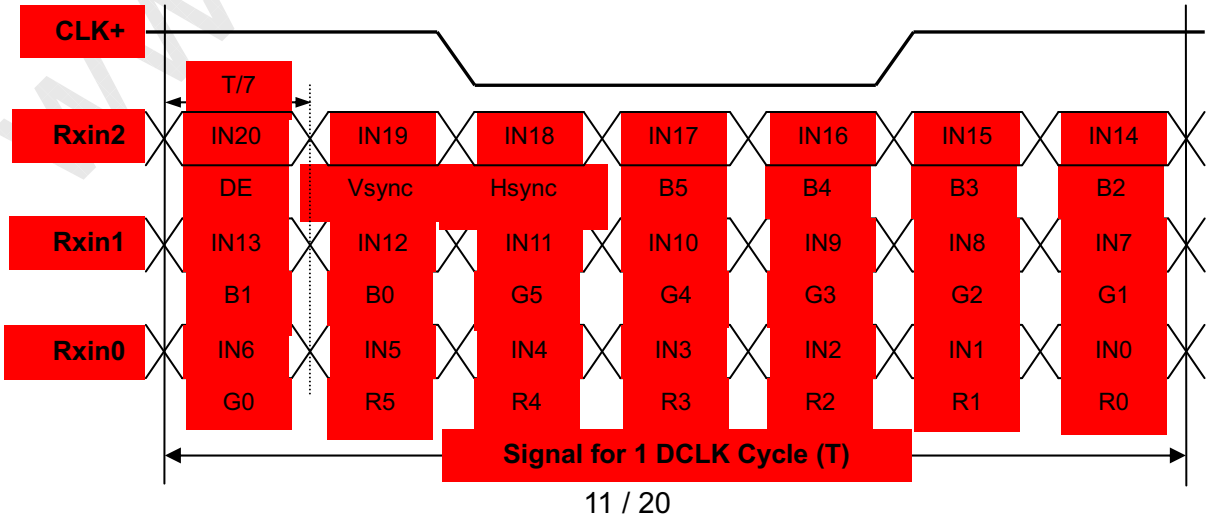
### 5.2 BACKLIGHT UNIT

| Pin | Symbol | Description | Color |
|---|---|---|---|
| 1 | HV | High Voltage | White |
| 2 | LV | Ground | Black |

Note (1) Connector Part No.: JST-BHTR-02VS-1 or equivalent

Note (2) User's connector Part No.: JST-SM02B-BHTS-B-TB or equivalent

### 5.3 TIMING DIAGRAM OF LVDS INPUT SIGNAL



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## 5.4 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

| Color | | Data Signal | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Red | | | | | | Green | | | | | | Blue | | | | | |
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Basic | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| Colors | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray | Red(2) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Scale | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| Of | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| Red | Red(61) | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Scale | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| Of | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| Green | Green(61) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Gray | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Scale | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| Of | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| Blue | Blue(61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

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# 6. INTERFACE TIMING

## 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The specifications of input signal timing are as the following table and timing diagram.

| Signal | Parameter | Symbol | Min | Typ | Max | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| DCLK | Pixel clock period | Tck | - | 15 | - | ns | |

**a.)DE Only Mode**

If 'Pin 18' is left open or pulled high, DE mode is selected. When N141X3 is working under DE mode, the signals, VSYNC and HSYNC, are ignored. All timing of timing controller is derived from DE signal.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| VSYNC | Vertical period | Tvp | 777 | 806 | 834 | Thp | |
| | Vertical display blank period | Tvdb | 9 | 38 | 66 | Thp | $T_{vdb}=T_{pw}+T_{bp}+T_{fp}$ |
| | Vertical display active period | Tvda | 768 | 768 | 768 | Thp | |
| | Vertical sync. back porch | Vbp | 0 | 29 | 65 | Thp | |
| | Vertical sync. front porch | Vfp | 0 | 3 | 65 | Thp | |
| | Vertical sync. pulse width | Vpw | 1 | 6 | 66 | Thp | |
| HSYNC | Horizontal period | Thp | 1342 | 1344 | 1356 | Tck | Need to be even |
| | Horizontal display blank period | Thdb | 318 | 320 | 332 | Tck | $T_{hdb}=H_{pw}+H_{bp}+H_{fp}$ |
| | Horizontal display active period | Thda | 1024 | 1024 | 1024 | Tck | |
| | Horizontal sync. back porch | Hbp | 24 | 105 | 331 | Tck | |
| | Horizontal sync. front porch | Hfb | 0 | 70 | 307 | Tck | |
| | Horizontal sync. pulse width | Hpw | 1 | 145 | 308 | Tck | |

Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note (2) The duration of DE signal must be longer than 1 clock period at every horizontal sync. period.

**b.) Standard Mode**

If 'Pin 18' is pulled down, Standard mode is selected. When Standard mode is used, VSYNC, HSYNC and DE should be provided.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| VSYNC | Vertical period | Tvp | 769 | 806 | 1000 | Thp | |
| | Vertical display blank period | Tvdb | 1 | 38 | 232 | Thp | $T_{vdb}=T_{pw}+T_{bp}+T_{fp}$ |
| | Vertical display active period | Tvda | 768 | 768 | 768 | Thp | |
| | Vertical sync. back porch | Vbp | 0 | 29 | 231 | Thp | |
| | Vertical sync. front porch | Vfp | 0 | 3 | 231 | Thp | |
| | Vertical sync. pulse width | Vpw | 1 | 6 | 232 | Thp | |
| HSYNC | Horizontal period | Thp | 1100 | 1344 | 1612 | Tck | Need to be even |
| | Horizontal display blank period | Thdb | 76 | 320 | 588 | Tck | $T_{hdb}=H_{pw}+H_{bp}+H_{fp}$ |
| | Horizontal display active period | Thda | 1024 | 1024 | 1024 | Tck | |
| | Horizontal sync. back porch | Hbp | 10 | 105 | 564 | Tck | |
| | Horizontal sync. front porch | Hfb | 0 | 70 | 554 | Tck | |



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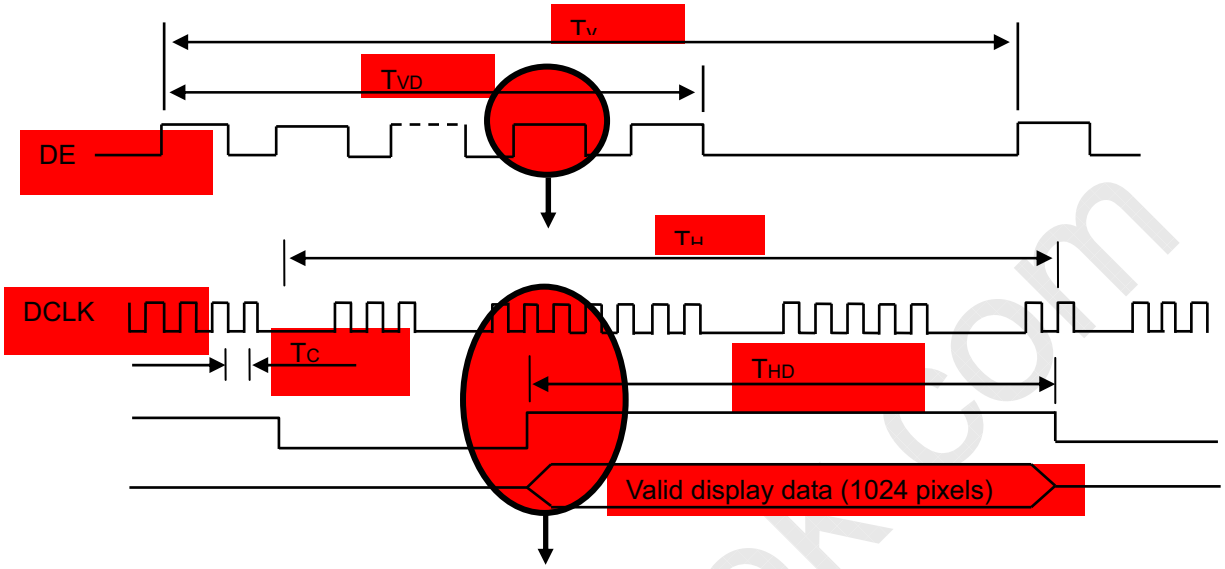
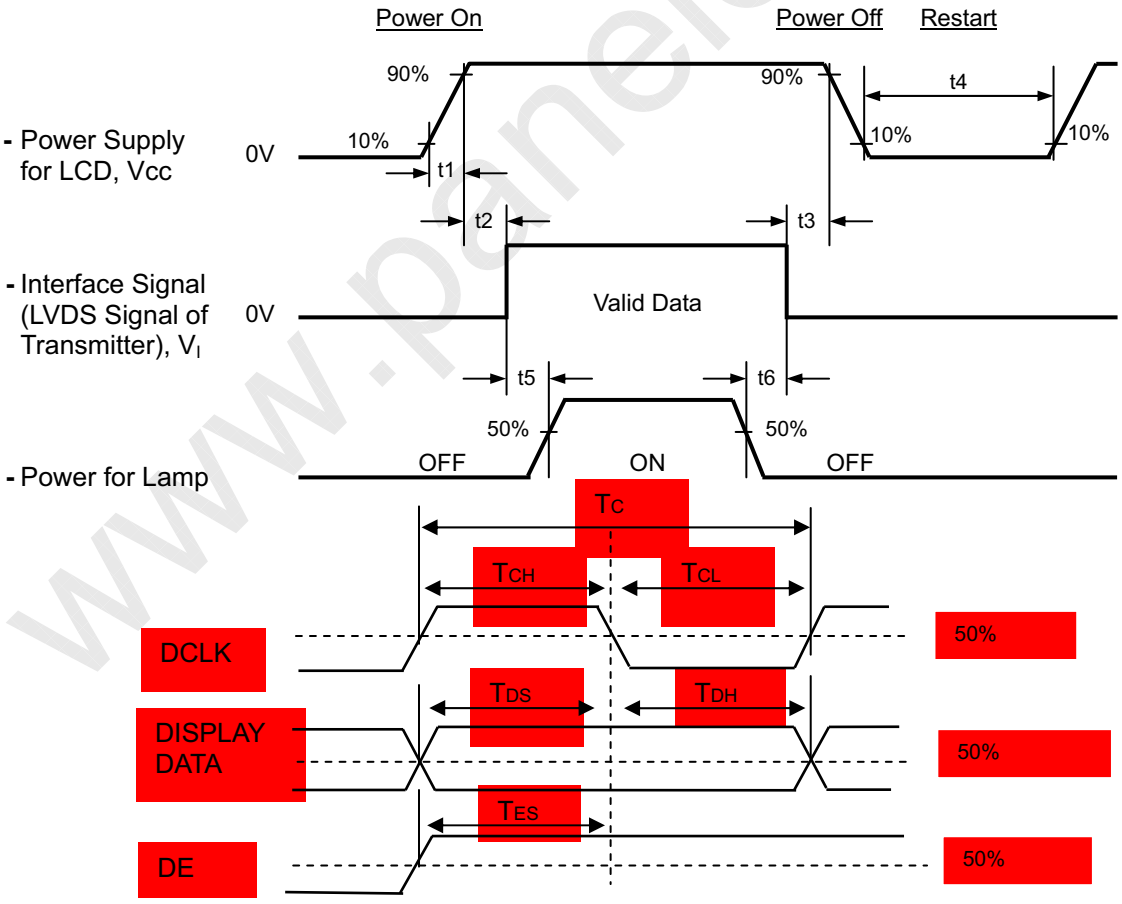
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Horizontal sync. pulse width | Hpw | 24 | 145 | 578 | Tck | |

**INPUT SIGNAL TIMING DIAGRAM**




6.2 POWER ON/OFF SEQUENCE



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Timing Specifications:

0 < t1 ≦ (10) msec

0 < t2 ≦ (50) msec

0 < t3 ≦ (50) msec

t4 ≧ 0.7 sec

t5 ≧ 170msec

t6 ≧ 200msec(min.)

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.

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# 7. OPTICAL CHARACTERISTICS

## 7.1 TEST CONDITIONS

| Item | Symbol | Value | Unit |
|---|---|---|---|
| Ambient Temperature | Ta | 25±2 | °C |
| Ambient Humidity | Ha | 50±10 | %RH |
| Supply Voltage | $V_{CC}$ | 3.3 | V |
| Input Signal | According to typical value in "3. ELECTRICAL CHARACTERISTICS" | | |
| Inverter Current | $I_L$ | (6.0) | mA |
| Inverter Driving Frequency | $F_L$ | (55) | KHz |
| Inverter | TBD | | |

The relative measurement methods of optical characteristics are shown in 6.2. The following items should be measured under the test conditions described in 6.1 and stable environment shown in Note (6).

## 7.2 OPTICAL SPECIFICATIONS

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | $\theta_x$=0°, $\theta_Y$ =0° Viewing Normal Angle | (150) | | - | - | (2), (6) |
| Response Time | | $T_R$ | | - | (15) | (30) | ms | (3) |
| | | $T_F$ | | - | (35) | (50) | ms | |
| Center Luminance of White | | L | | (120) | (150) | - | $cd/m^2$ | (6) |
| Average Luminance of White | | $L_{AVE}$ | | (110) | (140) | - | $cd/m^2$ | (4), (6) |
| White Variation | | δW | | - | (1.4) | (1.6) | - | (6), (7) |
| Cross Talk | | CT | | - | - | TBD | % | (5), (6) |
| Color Chromaticity | Red | Rx | | | (0.58) | | - | (1), (6) |
| | | Ry | | | (0.35) | | - | |
| | Green | Gx | | | (0.32) | | - | |
| | | Gy | | | (0.54) | | - | |
| | Blue | Bx | | | (0.15) | | - | |
| | | By | | | (0.14) | | - | |
| | White | Wx | | | (0.31) | | - | |
| | | Wy | | | (0.33) | | - | |
| Viewing Angle | Horizontal | $\theta_x$+ | CR≥10 | 40 | 45 | | Deg. | |
| | | $\theta_x$- | | 40 | 45 | | | |
| | Vertical | $\theta_Y$+ | | 10 | 15 | | | |
| | | $\theta_Y$- | | 30 | 35 | | | |



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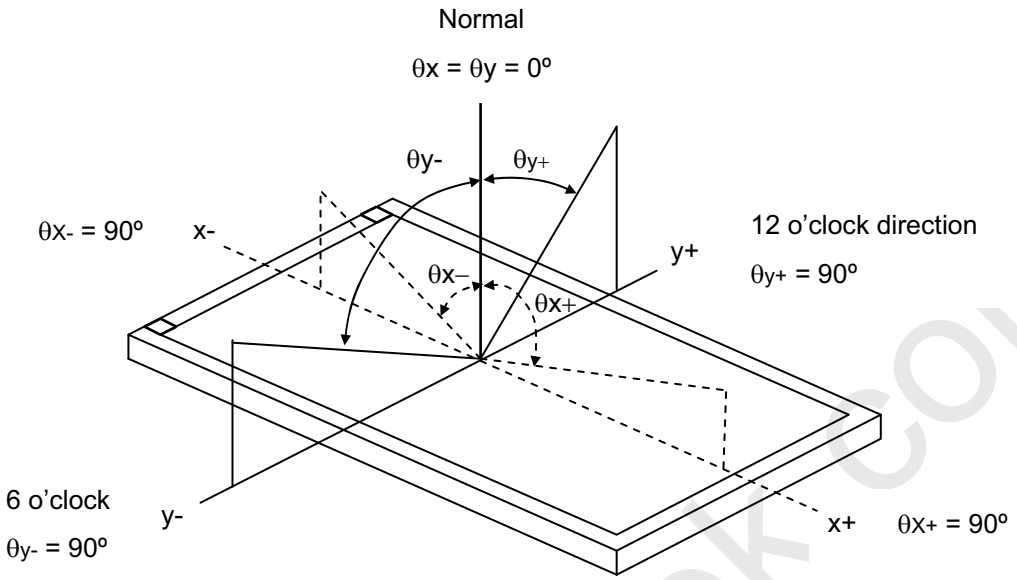
Note (1) Definition of Viewing Angle (θx, θy):




Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L63 / L0

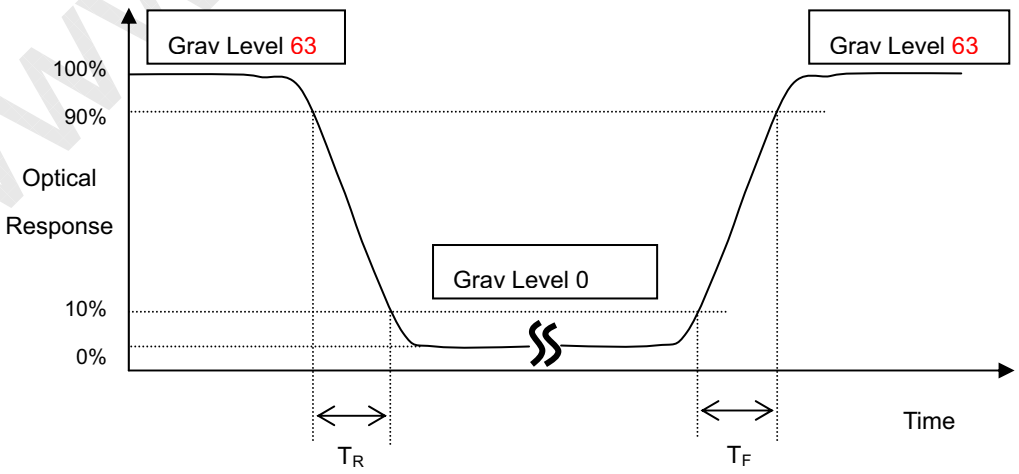
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

CR = CR (5)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (7).

Note (3) Definition of Response Time ($T_R$, $T_F$):



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Note (4) Definition of Average Luminance of White ($L_{AVE}$):

Measure the luminance of gray level 63 at 5 points

$L_{AVE}$ = [L (1)+ L (2)+ L (3)+ L (4)+ L (5)] / 5

L (x) is corresponding to the luminance of the point X at Figure in Note (7).

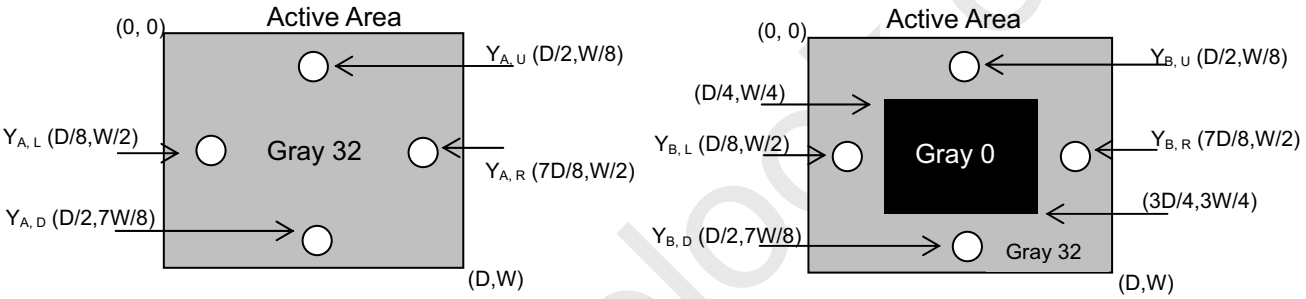
Note (5) Definition of Cross Talk (CT):

$CT = | Y_B – Y_A | / Y_A \times 100$ (%)

Where:

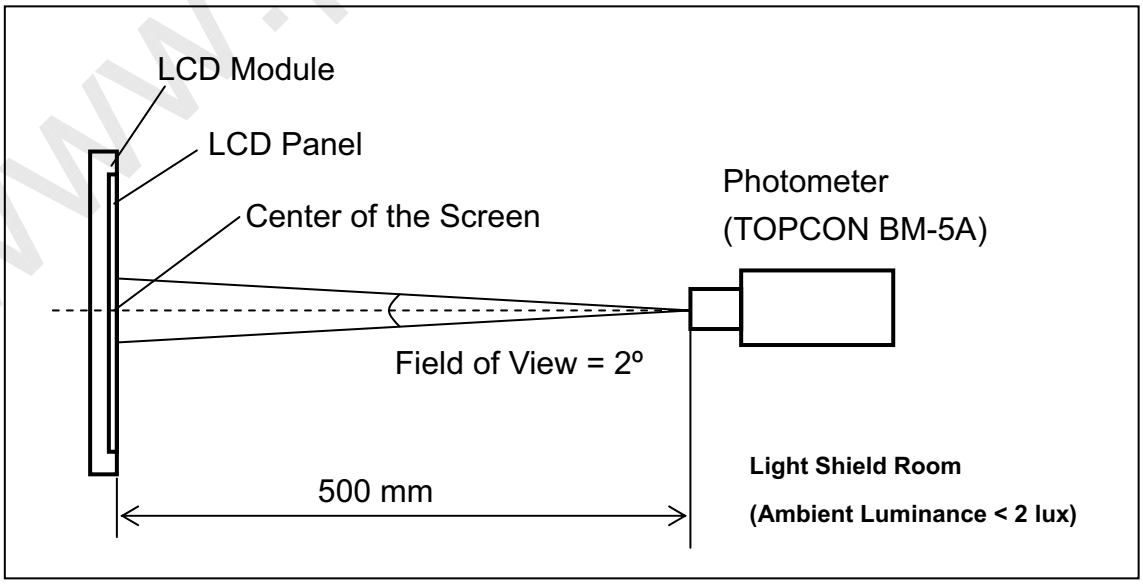
$Y_A$ = Luminance of measured location without gray level 0 pattern ($cd/m^2$)

$Y_B$ = Luminance of measured location with gray level 0 pattern ($cd/m^2$)




Note (6) Measurement Setup:

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



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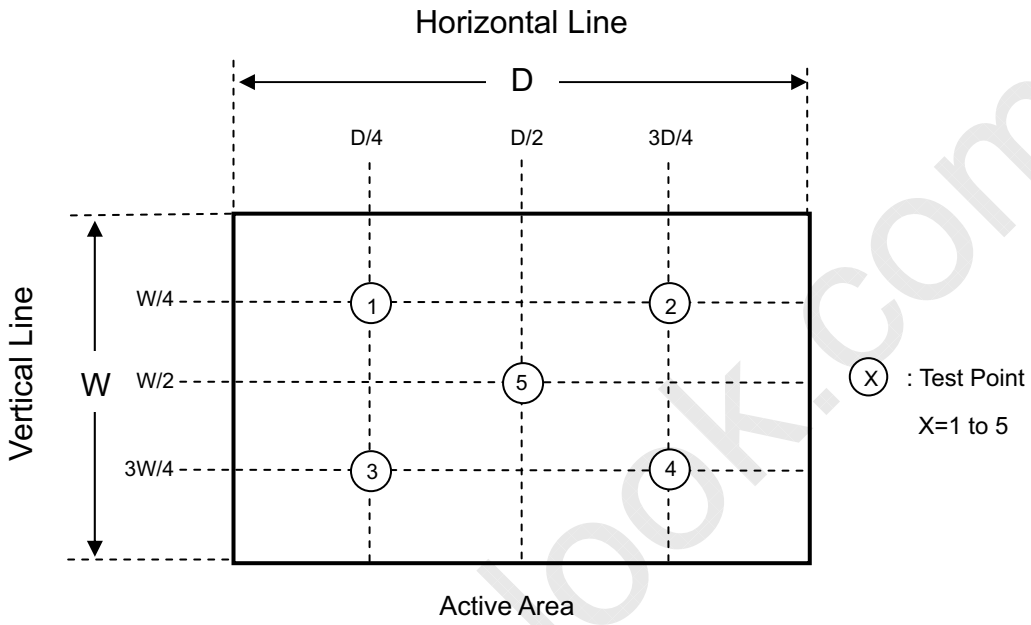
Note (7) Definition of White Variation (δW):

Measure the luminance of gray level 63 at 5 points

δW = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]

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# 8. PRECAUTIONS

## 8.1 ASSEMBLY AND HANDLING PRECAUTIONS

(1) Do not apply rough force such as bending or twisting to the module during assembly.

(2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.

(3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.

(4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.

(5) Do not pull the I/F connector in or out while the module is operating.

(6) Do not disassemble the module.

(7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.

(8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.

(9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.

(10) When ambient temperature is lower than 10ºC may reduce the display quality. For example, the response time will become slowly, and the starting voltage of CCFL will be higher than room temperature.

## 8.2 SAFETY PRECAUTIONS

(1) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with inverter. Do not disassemble the module or insert anything into the Backlight unit.

(2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.

(3) After the module's end of life, it is not harmful in case of normal operation and storage.



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